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| Question | |
| **Should backboard/floor vs. normal mattress/soft surface be used for cardiopulmonary resuscitation?** | |
| **Population:** | For adults or children in cardiac arrest (out-of-hospital and in-hospital) |
| **Intervention:** | The performance of CPR using a hard surface (e.g. backboard, floor, or deflatable or specialist mattress) |
| **Comparison:** | The performance of CPR on a regular mattress or other soft surface |
| **Main outcomes:** | 9 – Critical outcome : Survival with favourable neurological outcome  8 – Critical outcome: Survival  7 – Critical outcome: Return of spontaneous circulation  6 – Important outcome: CPR quality (compression depth, rate, fraction) |
| **Setting:** | All settings |
| **Perspective:** |  |
| **Background:** | Delivery of chest compressions on a soft surfaces (e.g. mattress), can lead to compression of both chest and surface, with up to 57% of compression absorbed by the mattress. This can have the dual impact of inadequate compression depth, and increased provider fatigue, as additional force is required to compensate for the mattress. Given these risks, compression quality may increase if the patient is on a firmer surface, such as a backboard, floor, compressed mattress or deflated mattress. However, modifying the patient surface risks interruption to compression and creating a more hazardous environment for CPR providers.  ILCOR has previously published a systematic review in 2010 and 2020 to describe the evidence on the impact of firm surfaces on CPR delivery. As per these reviews, the current ILCOR recommendation is to perform chest compressions on a firm surface when possible (weak recommendation, very low-certainty evidence). The aim of this systematic review is to update the 2020 ILCOR review and describe the evidence regarding CPR delivery on firm surfaces. |
| **Conflict of interests:** | Gavin Perkins has authored included research. |

# Assessment

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| Problem Is the problem a priority? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ○ Probably yes • Yes ○ Varies ○ Don't know | ILCOR recommends a chest compression depth of 5-6 cm to improve outcomes from cardiac arrest. When CPR is performed on a soft surface (e.g. mattress), the chest wall as well as the support surface is compressed. This has the potential to diminish chest compression depth delivered to the patient.  ILCOR last reviewed this topic as part of the 2020 evidence review. Since that time several studies have been conducted. |  |
| Desirable Effects How substantial are the desirable anticipated effects? | | |
| Judgement | Research evidence | Additional considerations |
| • Trivial ○ Small ○ Moderate ○ Large ○ Varies ○ Don't know | No studies reported patient outcomes or delays in CPR commencement.  There was minimal changes in chest compression depth in mannikin simulation studies between soft and firm surfaces.  No noted harms or adverse effects. |  |
| Undesirable Effects How substantial are the undesirable anticipated effects? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Trivial ○ Small ○ Moderate ○ Large ○ Varies • Don't know | Few studies reported undesirable effects. Rescuer fatigue and discomfort was greater when CPR was performed on a softer mattresses in one study (Ahn 2021). | Risks and difficulties in moving patient to the floor. |
| Certainty of evidence What is the overall certainty of the evidence of effects? | | |
| Judgement | Research evidence | Additional considerations |
| • Very low ○ Low ○ Moderate ○ High ○ No included studies | The certainty of evidence remains very low with only one very small single centre observational study and 17 simulated resuscitations on mannequins available.  Only one study used lay rescuers (Missel 2023). Manikins do not reflect the different sizes and weights of humans. | Most studies used inbuilt sensors in manikins to determine CPR quality.  The observational study (Picard 2022) used a handheld feedback device strapped to the patients chest to measure compressions -which may not be reliable when used on a mattress (Perkins 2009). |
| Values Is there important uncertainty about or variability in how much people value the main outcomes? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Important uncertainty or variability ○ Possibly important uncertainty or variability • Probably no important uncertainty or variability ○ No important uncertainty or variability | The ILCOR COSCA document identifies patient outcomes as important. |  |
| Balance of effects Does the balance between desirable and undesirable effects favor the intervention or the comparison? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Favors the comparison ○ Probably favors the comparison • Does not favor either the intervention or the comparison ○ Probably favors the intervention ○ Favors the intervention ○ Varies ○ Don't know | The Task Force supported performing chest compressions on a firm surface when possible as this reduces the risks of shallow compressions attributable to performing CPR on a soft surface.  In considering whether to transfer a patient from a bed to the floor to improve compression depth, the Task Force considered the risks of harm to the patient and resuscitation team outweighed any small improvement in chest compression depth, leading to a weak recommendation against routine use of this practice unless necessary.  The Task Force removed the prior treatment recommendation which was neither for nor against the use of backboards. This recommendation was thought to be confusing and is covered in recommendation for firm surfaces.  The Task Force removed the specific prior treatment recommendation for activation of a CPR mode on a mattress as this is covered in the recommendation for firm surface and is not supported by evidence. |  |
| Resources required How large are the resource requirements (costs)?" | | |
| Judgement | Research evidence | Additional considerations |
| ○ Large costs •  Moderate costs ○ Negligible costs and savings ○ Moderate savings ○ Large savings ○ Varies ○ Don't know | Some firm surfaces (e.g. backboards and CPR mode mattress) have additional costs. |  |
| Certainty of evidence of required resources What is the certainty of the evidence of resource requirements (costs)? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Very low ○ Low ○ Moderate ○ High • No included studies | Some firm surfaces (e.g. backboards and CPR mode mattress) may require specific training (e.g. manual movement of patients). |  |
| Cost effectiveness Does the cost-effectiveness of the intervention favor the intervention or the comparison? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Favors the comparison ○ Probably favors the comparison ○ Does not favor either the intervention or the comparison ○ Probably favors the intervention ○ Favors the intervention ○ Varies •  No included studies | No cost effectiveness studies. |  |
| Equity What would be the impact on health equity? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Reduced ○ Probably reduced ○ Probably no impact ○ Probably increased ○ Increased ○ Varies • Don't know | No evidence. | The cost of backboards/specialty mattress may not be affordable in resource restricted settings. |
| Acceptability Is the intervention acceptable to key stakeholders? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ○ Probably yes ○ Yes • Varies ○ Don't know | We have not identified any research that assessed acceptability. Although backboards and specialty mattresses are widely used in hospital settings. |  |
| Feasibility Is the intervention feasible to implement? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ○ Probably yes ○ Yes •  Varies ○ Don't know | Possible concerns around feasibility with single rescuer in the home environment but not studied.  Backboards and specialty mattresses are widely used in hospital settings. | Moving unconscious victims to a firm surface may not be feasible in all settings with lay rescuers. |

# Summary of judgements

|  | **Judgement** | | | | | | |
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| **Problem** | No | Probably no | Probably yes | **Yes** |  | Varies | Don't know |
| **Desirable Effects** | **Trivial** | Small | Moderate | Large |  | Varies | Don't know |
| **Undesirable Effects** | Trivial | Small | Moderate | Large |  | Varies | **Don't know** |
| **Certainty of evidence** | **Very low** | Low | Moderate | High |  |  | No included studies |
| **Values** | Important uncertainty or variability | Possibly important uncertainty or variability | Probably no important uncertainty or variability | **No important uncertainty or variability** |  |  |  |
| **Balance of effects** | Favors the comparison | Probably favors the comparison | **Does not favor either the intervention or the comparison** | Probably favors the intervention | Favors the intervention | Varies | Don't know |
| **Resources required** | Large costs | Moderate costs | Negligible costs and savings | Moderate savings | Large savings | Varies | **Don't know** |
| **Certainty of evidence of required resources** | Very low | Low | Moderate | High |  |  | **No included studies** |
| **Cost effectiveness** | Favors the comparison | Probably favors the comparison | Does not favor either the intervention or the comparison | Probably favors the intervention | Favors the intervention | Varies | **No included studies** |
| **Equity** | Reduced | Probably reduced | Probably no impact | Probably increased | Increased | **Varies** | Don't know |
| **Acceptability** | No | Probably no | Probably yes | Yes |  | **Varies** | Don't know |
| **Feasibility** | No | Probably no | Probably yes | Yes |  | **Varies** | Don't know |

# Type of recommendation

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| Strong recommendation against the intervention | Conditional recommendation against the intervention | Conditional recommendation for either the intervention or the comparison | Conditional recommendation for the intervention | Strong recommendation for the intervention |
| ○ | ○ | ○ | • | ○ |

# Conclusions

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| Recommendation |
| We suggest performing chest compressions on a firm surface, when this is practical and does not significantly delay the commencement of chest compressions (weak recommendation, very low certainty evidence).When performing chest compressions, we suggest against moving a patient from a bed to floor to improve chest compression depth (weak recommendation, very low certainty of evidence). |
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| Justification |
| In making these recommendations, the Task Force considered the importance of high-quality chest compressions and minimizing delays to the initiation of CPR to improve outcomes from in-hospital and out-of-hospital cardiac arrest.  Within the limitations of mannequin studies, the available evidence indicates the use of backboard only results in a marginal depth benefit and one that is unlikely to be clinically significant.  The lack of clinical studies reporting on the critical outcomes of favorable neurological outcome, survival, ROSC and delays to commencement of CPR.  The addition of two studies simulating out-of-hospital settings (where beds may be softer) and one where the CPR provider may be a single untrained rescuer, led to the Task Force to broaden the recommendations to include in-hospital and out-of-hospital cardiac arrest.  In considering whether to transfer a patient to the floor when performing chest compressions to improve compression depth, the Task Force considered the risks of harm (e.g. interruption in CPR, risk of losing vascular access if IV lines and more confined space) to the patient and resuscitation team outweighed any small improvement in chest compression depth. In addition, studies on bystander CPR report significant loss of time due to difficulties in moving the patient to the floor29 or that CPR is not performed at all because the patient could not be moved.29,30  Emergency Medical Services are likely to move patients in confined spaces to perform resuscitation. |

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| Subgroup considerations |
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| Implementation considerations |
| For healthcare systems that have already incorporated backboards into routine use during resuscitations, the evidence was considered insufficient to suggest against their continued use. For healthcare systems that have not introduced backboards, the limited improvement in compression depth and uncertainty about harms seemed insufficient to justify the costs of purchasing backboards and training staff in their use. Where backboards are deployed, users should be aware that mattress stiffness, backboard size and orientation influence their effectiveness |

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| Monitoring and evaluation |
| Health care services should monitor CPR metrics, but be aware that CPR feedback devices may not accurately measure compression depth when CPR is performed on a mattress. |

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| Research priorities |
| * Studies reporting clinical outcomes. * Studies examining the logistical aspects of backboard deployment or moving a patient from a bed to the floor. * Studies in both high and low-resource settings where hospital bed or pre-hospital stretcher configurations may vary. * No studies evaluating pediatrics. |

# References Summary